

Issued January 26, 1915.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF SOILS—MILTON WHITNEY, Chief.

SOIL SURVEY OF WASHINGTON COUNTY,
TEXAS.

BY

A. H. MEYER, E. C. ECKMANN, L. CANTRELL,
AND L. V. DAVIS.

HUGH H. BENNETT, INSPECTOR, SOUTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1913.]



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1915.

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ALBERT G. RICE, *Assistant to Chief.*

SOIL SURVEY.

CURTIS F. MARBUT, *In Charge.*
G. W. BAUMANN, *Executive Assistant.*

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., July 7, 1914.

SIR: In the extension of the soil survey in the State of Texas work was undertaken in Washington County and completed during the field season of 1913.

The accompanying report and map cover this survey and are submitted for publication as advance sheets of Field Operations of the Bureau of Soils for 1913, as authorized by law.

Very respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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FIGURE.

FIG. 1. Sketch map showing areas surveyed in Texas.....

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MAP.

Soil map, Washington County sheet, Texas.

SOIL SURVEY OF WASHINGTON COUNTY, TEXAS.

By A. H. MEYER, E. C. ECKMANN, L. CANTRELL, and L. V. DAVIS.

DESCRIPTION OF THE AREA.

Washington County lies in the southeastern part of Texas, about 90 miles east of Austin and about 120 miles from the Gulf of Mexico. The county is irregular in shape, the Brazos River forming the eastern boundary and Cedar Creek and Yegua Creek the northern boundary.

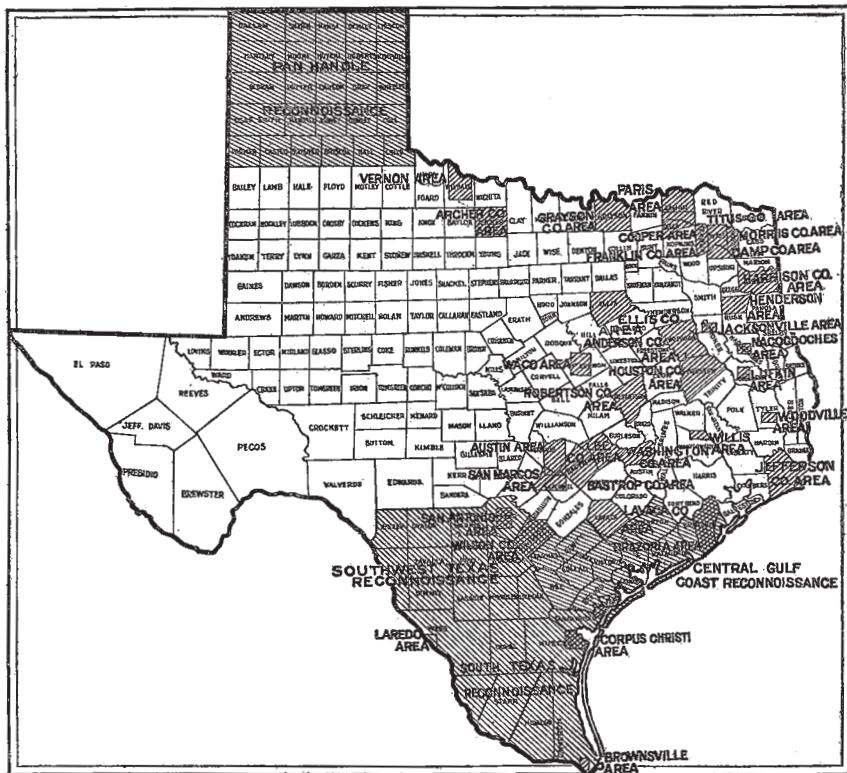


FIG. 1.—Sketch map showing areas surveyed in Texas.

It is bounded on the north by Lee, Burleson, and Brazos Counties, on the east by Grimes and Waller Counties, on the south by Austin and Fayette Counties, and on the west by Fayette and Lee Counties. The county comprises an area of 613 square miles, or 392,320 acres.

The surface of the county is dominantly rolling to gently rolling. In the eastern and northeastern section the upland gives way to the Brazos River bottoms, which vary in width from narrow strips to about 4 miles. Along the break between the upland and bottom land the country is more or less dissected, and in the northeastern part of the county the line of separation between the uplands and bottoms is in places marked by steep slopes or precipitous bluffs. In the western part of the county, about 3 miles west of Burton, the rolling to gently rolling upland merges with the lower undulating to level country, known as the "post-oak flats." The topography of a large part of the county is favorable to farming and to the use of labor-saving machinery.

The county has a general elevation of 200 to 350 feet above sea level. The highest point, 476 feet above sea level, is about three-fourths mile northeast of Old Gay Hill and the lowest point, 155 feet above sea level, is in the southeastern part of the county, in the Brazos River bottoms.

Drainage is generally good. An ill-defined drainage divide extends from about 1 mile north of William Penn through Independence, Gay Hill, and Burton, and thence along the Houston & Texas Central Railroad to the county line. From there it follows the county line to Lee County. North of this divide the streams are short and drain into Yegua Creek, which flows in a northeasterly direction along the county line into the Brazos River, and Cedar Creek, which unites with Yegua Creek at the junction of Lee, Burleson, and Washington Counties. South of the divide the streams are longer and flow in a southeasterly direction into the Brazos River. The eastern part of this drainage area is drained by Jackson, New Year, and Caney Creeks, and the western part by West Mill and East Mill Creeks. The greater part of the drainage is through the Brazos River and its tributaries. Along the edge of the county this river has a deep channel and a broad flood plain. The channels of the streams are generally deep and well defined.

The first permanent settlement by Anglo-Americans in Washington County was made in 1822 at Washington, the old State capital of Texas, one year after Texas won its independence from the Spanish Government. The county, which had been organized as a municipality under the Mexican Government, was established as a county in 1836, when Texas became an independent Republic. In 1845 Texas was annexed to the United States. Washington County was reduced in size in 1874, when the western section was added to Lee County.

The first settlers came from North Carolina, South Carolina, Virginia, Kentucky, and Tennessee. From 1859 to 1875 there was a

steady immigration, mainly of Germans, and between 1870 and 1880 the immigrants included a large number of Poles. The earlier settlers occupied the rich, black prairie lands of the county, while the later immigrants settled largely between Brenham and Chapel Hill. The renting of land was common among the latter class, mainly Poles, until about 15 years ago. The negro population is confined largely to the poor, sandy soils of the county. The greater part of the population is of German descent, with the Polish population probably second.

According to the United States census for 1910, Washington County has a population of 25,561. In 1900 a population of 32,931 is reported, and in 1890 it is given as 29,161. Brenham, the county seat, is a thriving city with a population of 4,718, as reported in the 1910 census. It is located in the south-central part of the county, in a good agricultural section. It is the most important trading center of the county. Several important industries are located at Brenham, including cotton mills, a foundry, a furniture factory, and a creamery. Chapel Hill, in the southeastern part of the county, is the second town of importance, and Burton, in the western part, is a close competitor. Mill Creek, Independence, Washington, William Penn, and Gay Hill are smaller villages.

The county has good transportation facilities. In all parts, except the northeastern corner, there is no point more than about 10 miles from a shipping station. The Houston & Texas Central Railroad crosses the county from east to west, passing through Chapel Hill, Brenham, and Burton. The Gulf, Colorado & Santa Fe Railroad crosses from northwest to southeast through Quarry, Gay Hill, Brenham, and Phillipsburg, and on to Galveston, either by way of Houston or Richmond. The latter is a direct route between Galveston and Fort Worth and Kansas City.

There is a ready market for sweet potatoes, Irish potatoes, small vegetables, dairy products, eggs, corn, and hay in the towns and cities of the county. In favorable seasons large quantities of potatoes are shipped to Kansas City and St. Louis. Fort Worth and Kansas City are the chief markets for beef cattle and hogs, the former being by far the more important. For cotton, Hamburg, Havre, and Liverpool are the principal markets.

There are not very many public roads in the county, but they are being gradually extended. The main public roads between the principal towns are in good condition, but those of less importance are generally neglected. During the rainy season the roads are at times impassable, but in the summer they are hard and smooth. The building of crushed-stone roads is being urged, and there is an

abundance of quartzite rock suitable for the purpose available at Quarry.

Washington County is well supplied with rural mail routes, and the telephone is in common use. The county is in a generally prosperous condition.

CLIMATE.

The climate of Washington County is mild and agreeable. The summers are long, but owing to the modifying influence of the Gulf breezes the heat is less intense than farther north, although a maximum temperature of 110° F. is recorded at College Station in Brazos County. The winters are short, and in normal seasons there is a large number of cloudy days. The temperature seldom falls below freezing. The absolute minimum temperature recorded at College Station is 5° F. North and northwest winds, known as "northerns," are common, but they seldom last more than three days. These winds often bring about a change in temperature of 40° in less than 24 hours. The annual mean temperature is about 67° F.

The mean annual precipitation is about 38 inches, and is well distributed throughout the year, being greatest during the winter and spring seasons. Occasional periods of dry weather occur in July or August, resulting in injury to growing crops. In normal seasons the damage from lack of moisture could be avoided by proper conservation of the rain water during the winter and spring. Snowfalls are rare, and disastrous winds or hailstorms seldom occur.

The average date of the first killing frost in the fall is November 20, and of the last in the spring, March 5. The earliest recorded in the fall is November 3, and the latest in the spring, March 24. The average growing season covers a period of 260 days, being long enough to gather two or more harvests of some crops.

There is no Weather Bureau station in this county. The data in the table below are compiled from the records kept at College Station, Brazos County, which is about 20 miles north of the center of Washington County. The local conditions are practically the same, so that the records are fairly representative of the temperature and precipitation of this county.

Normal monthly, seasonal, and annual temperature and precipitation at College Station, Tex.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.	Snow, average depth.
December.....	°F. 53	°F. 83	°F. 6	Inches. 3.5	Inches. 1.7	Inches. 0.1	Inches. 0.0
January.....	50	88	10	4.2	0.8	7.1	0.0
February.....	52	90	5	2.6	1.2	2.3	0.4
Winter.....	52	.....	.....	10.3	3.7	9.5	0.4
March.....	60	90	20	2.5	2.1	2.4	0.0
April.....	68	95	37	3.3	1.4	2.7	0.0
May.....	74	99	46	4.6	9.1	2.4	0.0
Spring.....	67	.....	.....	10.4	12.6	7.5	0.0
June.....	81	108	71	3.6	3.5	9.0	0.0
July.....	82	110	72	2.5	0.4	3.5	0.0
August.....	83	110	73	1.8	1.8	1.2	0.0
Summer.....	82	.....	.....	7.9	5.7	13.7	0.0
September.....	78	104	66	3.7	1.8	14.9	0.0
October.....	69	100	58	2.3	0.2	0.1	0.0
November.....	58	92	48	3.2	5.6	6.1	T.
Fall.....	68	.....	.....	9.2	7.6	21.1	T.
Year.....	67	110	5	37.8	29.6	51.8	0.4

AGRICULTURE.

From the earliest settlement of the county, agriculture was the dominant industry. Cotton, corn, and garden crops for home use were grown. The early methods were necessarily crude, oxen and wooden plows being used. The hoe and spade supplemented these farm implements. The agricultural population spread gradually from the vicinity of Washington over the eastern half of the county.

As there were no railroads, the cotton was transported down the Brazos River and shipped from Galveston to European markets. With the completion of the Houston & Texas Central Railroad from Hempstead to Brenham in 1859, an impetus was given to the cotton industry and agriculture was greatly extended. During the Civil War the industry suffered a marked decline, but after the war it increased rapidly owing to the materially increased population, which, consisting largely of Germans, constituted a good agricultural class. Efforts were made to improve the grade of cotton, and in a

short time the product won a good reputation in European markets. It was known as Brenham cotton, and produced a long fiber of excellent quality.

In 1870 the Houston & Texas Central Railroad was extended to Austin, and in 1879 the Santa Fe was built across Washington County, affording transportation for all agricultural products and materially shortening hauling distances. As a result the cotton industry progressed rapidly until the advent of the boll weevil in 1901. The production of cotton decreased from 54,724 bales in 1899 to 17,091 bales ginned in 1907. Since then the introduction of methods designed to prevent damage by the boll weevil has resulted in an improvement in conditions. In the census for 1910 a production of 32,996 bales is reported, and according to the census¹ 41,084 bales were ginned in 1912. It is thus seen that there has been a marked recovery from the low ebb of cotton production in 1899. This recovery has been brought about by the selection of early varieties and better soil management.

Corn has been an important crop from the beginning of agriculture in the county, but it has never been a cash crop like cotton. It is fed to live stock or ground into meal. The crop reached its greatest importance in point of acreage about 1880, and since then has remained about stationary, though the yield has almost doubled. In 1880, 571,663 bushels were produced from 43,610 acres, and in 1910, 1,084,486 bushels from 45,035 acres. The increase is apparently due to better seed selection and better soil management.

Oats have never become a very important crop, owing to rust infection. The greatest total area ever devoted to the crop was 776 acres, in 1879, with a production of 22,727 bushels. Since then it has gradually declined. The 1910 census reports a production of 2,339 bushels from 154 acres in 1909. Profitable production of the crop will depend upon the discovery of means to control the rust. The Texas Rust Proof variety is not as subject to infection as the others grown, but even this variety is not satisfactory.

There has been very little change in agricultural practices since the settlement of the county. The principal crops grown, in order of acreage, are cotton, corn, hay, Irish potatoes, small vegetables, sugar cane, sweet potatoes, oats, peanuts, and cowpeas.

The hay crop consists of Johnson grass, Bermuda grass, millet, alfalfa, and grains cut green. Most of the hay is grown on the bottom land of small streams, except alfalfa, which is grown on the upland. The climate and most of the soils of the county are well suited to alfalfa. The Houston black clay and the Miller clay where protected from overflow, are apparently the two best soil types for this crop.

¹ Bul. No. 116, U. S. Census.

Three and sometimes four cuttings are made each year, the total yield ranging from 3 to 5 tons per acre. Alfalfa is an excellent hay for cattle and horses. It is also a good soil renovator. In 1909, there were 101 acres devoted to alfalfa, with a production of 341 tons.

Special crops have not received much attention in this county. On practically all of the farms a few acres are devoted to Irish potatoes and sweet potatoes, and the surplus products are sold. In favorable seasons the surplus from the various farms amounts to a considerable output, which is shipped either to Kansas City or St. Louis. On a number of the farms Irish potatoes are grown profitably for early market. There is an excellent opportunity for the extension of this industry on the sandy soils of the county. Small vegetables are grown extensively in the vicinity of Brenham for local markets. The sandy soils are well adapted to such crops, but the market is limited.

Nearly every farmer grows enough sugar cane to supply home needs. It does well, producing from 100 to 200 gallons of sirup per acre. The best quality of sirup is obtained from cane grown on the Crockett soils. Peanuts were first grown about 1900, and in 1909 a production of 2,364 bushels from 112 acres is reported. Velvet beans and cowpeas have only been grown to a small extent in this county. The sandy soils are suited to these crops, which are not only profitable in themselves but benefit the soil by adding nitrogen.

The fruit industry has never been given very much attention in Washington County. Strawberries do well, but have not been grown on a commercial scale. Peaches and pears have never been grown commercially, and figs are likely to be winterkilled. However, peaches, pears, and plums are grown for home use.

With the decline of cotton production, due to the advent of the boll weevil, considerable attention was given to dairying, and in 1907 a modern creamery commenced operations in the county. The magnitude of the dairy industry is very accurately shown by the output of this factory. During the summer of 1912, approximately 15,000 pounds of butter were made, and during the winter something less than 10,000 pounds. Only cream is purchased from the farmers. Most of the butter is shipped to Galveston, some being sent to Houston. The supply does not nearly meet the demand. In addition, a small amount of ice cream is made for local consumption. Owing to the high price of cotton and the decreased damage by the boll weevil, dairying has so far been taken up only as an incidental industry, but the appreciation by the farmers of the necessity for crop rotation and diversified farming and the profit to be made in mixed farming is bringing about a change in their attitude toward the dairy industry. More attention is being given to the systematic management of the dairy herd, in selecting improved breeds, in careful feed-

ing, and in the sanitary handling of the milk. The creamery receives the product of approximately 250 farms, on each of which 4 to 5 cows are kept.

The greater part of the dairy cattle are grades, although there are a few pure-bred Jerseys in the county. A cross between the Durham and Jersey seems to be the favorite grade.

Comparatively few beef cattle are raised. They generally range on the bottom lands of the county and are shipped mainly to Fort Worth and to Kansas City. Throughout the county "beef clubs," with an average membership of 12 farmers, have been organized. Every week during the summer one member of the club slaughters an animal and divides the cuts among the others in such a way that each farmer receives a different part each week, thus supplying all of the members of the club with fresh meat during the warm weather.

The hogs are generally of mixed breed. They are raised on practically all the farms in the county, and about half of the farmers sell from 5 to 10 animals a year. They are shipped to the same markets as the cattle.

A small number of sheep are raised in the county, mainly on land which can be cultivated only with difficulty.

The work stock consists principally of mules, although horses are also used. Many farmers raise their own work stock, and occasionally have a team to sell. In the raising of mules greater care is being exercised in the selection of heavy, sound mares and well-developed jacks.

Very little attention is given to the adaptation of soils to crops. Cotton and corn are grown on all the soil types of the county, though on the lighter soils other crops would probably be more remunerative. No system of crop rotation is followed; cotton and corn are either grown continuously or in alternation year after year. Ridge cultivation is still practiced. Cotton seed and a small amount of barnyard manure are used as fertilizers, but owing to the productiveness of the greater part of the soils of this county practically no commercial fertilizer is used. Nearly all the fields are infested with cocklebur and a large number with Johnson grass and Bermuda grass. Much of the land along the Brazos River is protected by levees.

On farms operated by their owners the buildings are usually well kept, considerable attention being given to the general appearance of the homesteads. The tenant-houses are usually small, box-shaped shacks with few windows. Most of the fences are of barbed wire, though woven wire is used in places.

Very little trouble is experienced in securing farm labor except during the cotton-picking season, when it is almost impossible to hire help for any other kind of work. Both colored and white laborers are usually available. The laborers are paid \$10 to \$15 a month,

with board, or 65 cents to \$1 a day. As a rule most of the work on the farm is done by the farmer and his family, except in the cotton-picking season when additional hands are hired.

According to the census for 1910, 42.5 per cent of the farms are operated by owners. The share and cash systems are both used in renting. Under the former the owner receives one-third of the corn and one-fourth of the cotton as rent. Cash rent varies from \$3 to \$6 an acre, depending on the productiveness of the land. The number of farms operated by the owners is gradually increasing. The average size of the farms is 94.3 acres.¹ The value of the land varies widely, depending on the character of the soil, topography, distance from market, and improvements. The lowest in value are the Lufkin and Crockett soils and the Trinity clay, which sell for \$10 to \$50 an acre. The highly improved soils, such as the Houston black clay, Houston loam and Miller clay, have a value of \$50 to \$100 an acre.

Although the agriculture of the county is generally prosperous, certain improvements in the methods commonly followed are being made. The advantages of more diversified farming are being appreciated, and this form of agriculture is replacing the prevailing one-crop system. Excellent opportunities are offered through the extension of the beef and dairy industries. It is being recognized that the growing of feed for stock, particularly alfalfa, on the farm is a profitable practice. Great benefits are derived from the liberal use of manure on the farm, and less cotton seed is being applied directly to the soil, being fed to milch cows and only the manure used as fertilizer. Better judgment is being exercised in the selection of cotton and corn seed. The most careful farmers select the cotton seed in the field from the stalks producing the best quality and largest quantity of lint before the cotton is picked. The seed corn is selected from the best stalks. There is a general need for more thorough tillage, deeper plowing, and the conservation of soil moisture.

SOILS.

The soils of Washington County range from a heavy waxy clay through a loam and sandy loam to a loamy sand and fine sand. From the standpoint of formation they may be separated into two general divisions—the upland or residual soils and the lowland or alluvial soils. The Houston, Crockett, and Lufkin series comprise the upland soils and the Miller and Trinity series the bottom soils. All the series in this county except the Trinity include two or three types. Most of the soils belong to the clay group, though the lighter or sandy soils are well represented. Some of the most productive clay soils of Texas occur in this county, and are well adapted to the production of cotton and corn.

¹ The census tabulates each tenancy as a "farm."

The rocks that underlie Washington County are nearly horizontal, having only a slight dip or slant southeastward. The dip is so gradual that it is not perceptible to the eye at any one locality. The lowest rock lies in the northwestern part of the county and the highest in the southeastern part. The lowest beds, or those from which most of the soils in the northwestern part of the county are derived, consist of hard blue clay and of moderately hard sandstone beds alternating with clay beds. These rocks extend from about 2 miles west and northwest of Burton to the Lee County line. They have disintegrated into the Lufkin fine sandy loam and fine sand. The characteristic tree growth on these soils consists of post oak and blackjack oak.

Overlying these beds and outcropping or lying beneath the soil in a belt southeast of the Lufkin belt a series of limy sands, limy clays, and red clay occurs. These weather into the Crockett soils mainly, but also into the Houston soils in places. The most important difference between these rock beds and the resulting soils and those beds underlying the Lufkin belt and their soils is the presence of an abundance of lime in the composition of the former. These soils occur in the northern part of the county, extending north from the drainage divide, described in the first chapter of this report, to the Yegua Creek flood plain and in the northwestern part of the county immediately southeast of the Lufkin belt.

Above the limy beds which form the Crockett soils, named in order from the bottom upward, a series of chalky clays with pockets of marl, grayish or yellowish-gray calcareous sandstone, and sandy clays and clays occurs. The chalky clays and calcareous sandstones weather into the various members of the Houston soils, and the sandy clays into Crockett soils. The area in which the Houston soils occur is prairie land, while most of that in which the Crockett soils occur is or was forested.

Certain fragmentary gravelly deposits are spread locally over the other or older beds in the western part of the county. They give rise to the coarser members of the Lufkin series of soils. These areas support a growth of post oak and blackjack oak where not cleared for cultivation.

The Miller series is derived from the recent alluvium occurring along the Brazos River bottom. This alluvium is derived to a large extent from the Permian Red Beds in northern Texas. Smaller areas of alluvial material are developed along the smaller streams which rise either in this county or in neighboring counties. In these areas the alluvium is derived largely from the Houston series and gives rise to the Trinity soil.

Eleven soil types are recognized in Washington County. The following table shows the actual and relative extent of the several types:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Houston black clay.....	127,104		Miller very fine sandy loam..	5,760	1.5
Eroded phase.....	896	32.6	Lufkin gravelly sandy loam..	3,712	.9
Crockett fine sandy loam.....	98,560		Crockett sandy loam.....	3,584	.9
Deep phase.....	4,672	26.3	Houston clay loam.....	2,176	.6
Houston loam.....	61,568	15.7	Lufkin fine sand.....	192	.1
Trinity clay.....	38,848	9.9	Total.....	392,320	-----
Lufkin fine sandy loam.....	26,368	6.7			
Miller clay.....	18,880	4.8			

BLACK SOILS.

RESIDUAL MATERIAL—LIMESTONE.

HOUSTON SERIES.

The Houston soils are black. These soils, particularly the subsoils, are high in lime, the subsoils of some types consisting of white, chalky limestone. The series is developed principally in the black calcareous prairie regions of Alabama, Mississippi, and Texas. The material is derived from the weathering of calcareous clays, chalk beds, and rotten limestones, all of Cretaceous age. In some localities remnants of later sandy and gravelly deposits have been mixed with the calcareous material, giving rise to the gravelly and loam members of the series. The black clay, clay loam, and loam are the only Houston types found in Washington County.

HOUSTON LOAM.

The Houston loam is rather variable, being an intermediate type between the Houston black clay and the Crockett fine sandy loam. The average soil is a grayish-black to dark-brown loam which becomes heavier with depth, the lower part of the surface soil being in many places an almost black, heavy fine sandy clay loam. At about 10 to 20 inches the subsoil is encountered. This consists of a dark-gray sandy clay or sandy clay loam mottled with yellow to yellowish brown. The subsoil is rather stiff and plastic and becomes lighter in color with depth. Some pockets of light-colored calcium carbonate are occasionally encountered in the subsoil. In places fossil shells are scattered on the surface and throughout the soil section.

While the type may be taken as described above, the soil varies from a dark-brown to black sandy loam or heavy sandy loam, through a loam, to a heavy fine sandy clay, while the subsoil varies from a

dark-gray heavy clay to a yellowish-brown sandy loam or sandy clay. In areas where the Crockett material is near the surface, gray clay mottled with reddish yellow and even dull red is encountered in the lower part of the subsoil. Calcareous sandstone is sometimes encountered within the 3-foot section, and fragments of such material are scattered over the surface of some areas.

On the slopes of drainage ways and on the crests of ridges a heavy phase of this type is developed. This consists of a dark-brown loam to silty clay loam, underlain at about 10 to 15 inches by a yellow compact clay which becomes pale yellow below and contains in many places whitish calcareous material. There are also included with this soil type patches of Houston black clay. These several variations in texture occur in such small areas that it is impossible to separate them on a map of the scale used in the survey.

The Houston loam is, as a rule, high in organic matter. It is neutral, as shown by the litmus test. It is spoken of by the farmers as "half land."

Owing to the relatively high percentage of sand, the type is easier to handle than the Houston black clay, and can be cultivated under a comparatively wide range of moisture conditions. If plowed when too wet it cracks and checks to some extent, but not enough to cause excessive loss of moisture. It is fairly resistant to drought, crops suffering from lack of moisture only during exceptionally long periods of dry weather.

The largest areas of the Houston loam are in the northern half of the county, although small areas are distributed throughout other sections. One fairly large area occurs in the vicinity of Greenvine. The surface is gently rolling to rolling with occasional steep slopes. Drainage is good and erosion not excessive.

Some of the larger areas of this type were originally prairies. The smaller areas generally supported a growth of post oak, hackberry, hickory, prickly ash, yaupon, and brambles. Most of the type is cleared, except along steep slopes.

Next to the Houston black clay, the Houston loam is the best upland agricultural type in the county. It is well adapted to the production of cotton, corn, Johnson grass, alfalfa, and a number of forage crops such as cowpeas, sorghum, vetch, and bur clover. Cotton yields from one-third to one-half bale to the acre, but with proper cultivation and fertilization as much as 1 bale has been obtained. Of late the boll weevil has done very little damage, except where cotton is planted late. Johnson grass produces an average of 3 tons of hay to the acre. Very little of this grass is grown, as it is considered a nuisance in cultivated fields. Owing to its calcareous nature, the type is well suited to alfalfa which yields from 3 to 5 tons of hay, with three cuttings per season. Irish potatoes and sweet

potatoes are grown successfully, but do not do as well as on the lighter soils of the county. Oats are grown on a small acreage only, owing to the prevalence of rust.

The one-crop system is generally practiced on this type and practically no commercial fertilizer is used. Cottonseed meal is applied to the soil by some farmers, although in many cases all cotton seed is sold. As a rule manure is added at the rate of 3 to 4 tons per acre every three or four years. The plowing under of an occasional crop of cowpeas, bur clover, or vetch is practiced to aid in maintaining the productiveness of the land.

Land of this type sells for \$40 to \$80 an acre, depending on improvements.

HOUSTON CLAY LOAM.

The soil of the Houston clay loam consists of a dark-gray or grayish-brown to nearly black silty clay loam or clay loam, 8 to 15 or 20 inches deep. It is underlain by a yellow calcareous clay passing quickly into a mixture of yellow clay and white chalky material, apparently rotten limestone. The white material increases in quantity with depth, and in places it constitutes the greater part of the lower subsoil. In some areas the darker surface soil has been washed off, bringing the lighter colored material near enough to the surface to give a light-gray color to the type. This soil has a much lower organic-matter content than the Houston black clay.

At just the right moisture content this type is very easy to handle, but when it is fairly dry plowing is difficult. This condition is apparently due in part to the partial cementation of the soil particles with lime. The type retains moisture well.

The Houston clay loam type has a patchy occurrence, mainly in the vicinity of Valley Ford School, Zionsville, and Longpoint. Besides these developments there are a number of small areas scattered throughout the middle part of the county. In most cases this soil is surrounded by typical Houston black clay.

The type occupies knolls, the crests of ridges, and steep slopes along stream channels throughout the black prairie land. The drainage is good. The land does not hold water in depressions or ponds, as some of the other soils do. There are very few gullies in the type, although considerable care is necessary to prevent surface wash.

Corn and grasses do well on this soil, and most of the type is devoted to their production. Corn yields 40 to 50 bushels an acre. The grasses are largely used for pasturage, as the fields are green throughout the growing season. Cotton grows well for two or three weeks after planting, when it frequently dies. The cause of this early loss of the cotton crop is not definitely known. Cowpeas and other

peas do well, but very little land is devoted to their production. Irish potatoes are grown occasionally, with good results. Practically all of this type is under cultivation.

No commercial fertilizers and but little barnyard manure have been used. The plowing under of an occasional crop of cowpeas, bur clover, or vetch would improve the land greatly by increasing the organic-matter content.

The price of land of this type of soil ranges from \$40 to \$60 an acre.

HOUSTON BLACK CLAY.

The typical Houston black clay consists of a black or nearly black clay which grades downward through a dark-gray, stiff, heavy clay into a drab, dark-drab, or gray, plastic, waxy clay, mottled with yellow. The latter usually begins at about 16 to 24 inches and frequently contains a whitish, calcareous material in spots or small pockets and a number of black oxide of iron concretions. When dry the soil is loose and granular, but when wet it is very waxy and sticky. In places small fossil shells are scattered over the surface and disseminated throughout the soil section. The substratum usually consists of a light-gray, calcareous clay, slightly mottled by the admixture of yellowish clay. This light-colored substratum material is seldom encountered at less than 4 to 5 feet from the surface, although it is within the 3-foot section in eroded places, and is sometimes exposed in gullies and severely washed spots. Along the upper slopes and the crests of ridges the soil is often only 2 or 3 inches deep, and is in places absent. At the foot of slopes and in depressions it is frequently over 3 feet deep. As the color of the soil indicates, this type has a high organic-matter content.

While the greater part of the soil in this county is typical, there are a few variations. Some patches in which the surface soil is very black and waxy, and extremely sticky when wet, occur mainly south of Longpoint. On or near the crests of ridges there are occasional patches in which a grayish to yellowish arenaceous limestone or calcareous sandstone occurs in beds, usually not more than 6 to 8 inches thick, within the 3-foot section. The type also includes a large total area of a lighter colored, brownish phase which was not separated from the darker typical soil only because of its patchy occurrence and irregular distribution. This phase really represents eroded areas; that is, areas from which the darker colored surface soil has been washed off, bringing the yellowish subsoil material to or nearly to the surface. This phase is confined to the steeper slopes and sharper ridge-crests and hilltops. It represents a rather close approach to the Houston clay. Moderate quantities of sand mixed with the surface material impart a rather loamy character to small

areas associated with the sandy rocks referred to above. Marginal strips near the sandy types are often somewhat loamy.

The Houston black clay, commonly known as "black land," is the most difficult soil in the county to cultivate. It can not be worked satisfactorily when very wet because of its extremely adhesive nature. If worked when the moisture conditions are most favorable, that is just after the soil has dried sufficiently not to be sticky, it breaks up into granules, but if cultivated subsequently when too wet the granules coalesce, and form lumps or clods. These, however, owing to the high lime content, disintegrate or pulverize rapidly on drying out. It is much easier to secure a good condition of tilth on this type than on a soil of equally heavy texture but having a lower lime content. Unless the surface is continually cultivated it cracks into irregular blocks with fissures several inches wide and 2 to 3 feet deep.

This type comprises the greater part of the uplands of Washington County. The largest area occurs in the vicinity of Burton. It extends south from there to the county line, north to the Yegua Creek bottoms and northeast until it crosses the Gulf, Colorado & Santa Fe Railroad as the predominant upland type, giving way to the Houston loam and Crockett fine sandy loam. The second largest area is in the southeastern part of the county, between Stone and the bottom lands of the Brazos River. In addition to these, a number of smaller areas are scattered throughout the county. The type is always more or less interspersed with areas of the Crockett fine sandy loam.

The characteristic topography of the Houston black clay is gently rolling to rolling, with gentle, regular slopes and broad divides of almost flat or slightly arched surface. The surface drainage is mainly good. On the broad, flatter divides, ditch or tile drainage is advantageous. Improved drainage results in a warmer, drier soil, which allows cultivation earlier in the spring. This is an important matter in the production of cotton, particularly in regions infested with the boll weevil. Comparatively little gullying has occurred, but great care is necessary to prevent erosion, and on moderately steep slopes contour plowing and terracing are necessary.

The Houston black clay is derived in situ mainly from calcareous clays or arenaceous limestone. Both soil and subsoil are highly calcareous, the subsoil containing sufficient lime to effervesce strongly with hydrochloric acid.

Most of this type was originally covered with prairie grass, with a scattering of live oak and along the streams red cedars. The marginal areas and small areas of Houston black clay were originally forested with oak. Of late a species of mesquite and some prickly pear have grown up in some of the uncultivated fields.

Cotton and corn are the principal crops grown on this type. The soil is well adapted to both of these crops, but about twice as much land is devoted to cotton as to corn. Corn averages from 35 to 40 bushels, and cotton one-third to one-half bale to the acre, though by careful cultivation higher yields of both crops can be obtained. A very small acreage is devoted to oats. Owing to the severity of rust this crop does not do well. The Texas Rust Proof variety has been tried but has not met with success, as it also is affected more or less by rust. Sorghum does well, but is only produced for sirup for home consumption. The type is well adapted to alfalfa, and while this crop is grown on only a few farms, its value is coming to be recognized, and the total acreage devoted to it is being extended. It yields from 3 to 5 tons per acre, depending largely on the rainfall during the summer and fall. Several grasses also do well on this type. The soil is suited to the production of lespedeza, bur clover, sweet clover, and vetch. About 90 per cent of the Houston black clay is under cultivation.

At present no regular system of crop rotation is practiced, except that cotton and corn are frequently alternated. No commercial fertilizers are used but cotton seed is used as fertilizer on most of the farms, and 3 to 4 tons of manure per acre every 3 or 4 years.

The Houston black clay is the most productive upland soil in the county. Though it is still a strong soil, it is slowly depreciating under the one-crop system generally practiced. The systematic rotation of crops is necessary to maintain and increase the productiveness of the soil. The water-holding power and general productiveness of the lighter colored phase may be improved by deeper plowing and by turning under vegetable matter, such as green cowpeas, clover or vetch, or even oats and rye.

The value of this type ranges from \$50 to \$100 an acre, depending on location and improvements.

Houston black clay, eroded phase.—An eroded phase is indicated on the map by cross lines. This phase includes severely eroded or gullied areas of the Houston black clay, which can not be profitably cultivated or which can not be cultivated at all because of the dissected surface. Some of the gullies are 10 to 15 feet deep, and are gradually extending. Most of these areas could be reclaimed by filling the gullies with brush, rock, and soil, and by seeding to soil-binding crops such as bur clover, sweet clover, and Johnson grass. The soil material between the gullies is generally similar to the lighter colored phase of the Houston black clay, while that in the gullies is mostly a whitish and yellowish clay like the substratum of the Houston series.

WATER-LAID MATERIAL (RECENT ALLUVIUM)—MIXED DERIVATION.

TRINITY SERIES.

The Trinity soils are predominantly black, ranging to dark brown. They occupy first-bottom alluvial lands, usually being developed as flat lands in comparatively shallow stream valleys. They are derived mainly from material washed from soils of the Houston series.

TRINITY CLAY.

The soil of the Trinity clay consists of a black clay which becomes stiffer and more compact with depth. At about 24 to 30 inches a somewhat lighter colored, stiff, waxy clay, usually drab or dark drab in color, is encountered, and this continues to a depth of 3 feet or more. When wet the surface soil is plastic and sticky, but it cracks and granulates on drying, assuming a favorable structure. In local areas the type has been considerably influenced by wash from near-by upland sandy soils, such as the Crockett, deep layers of sand having been washed down over the surface during heavy rains, but such areas are not large enough to be shown separately on the map. The shifting of the stream channels has caused considerable variation in the stratigraphy of the soil section. In many places the typical Trinity clay is underlain at 18 to 24 inches by a seam of brownish-gray sand, which varies in thickness from a few inches to nearly 2 feet. Both the soil and subsoil contain much lime. A high percentage of organic matter gives the soil its characteristic dark color.

Owing to its dense structure, this soil can only be handled under a narrow range of moisture conditions. While heavy teams are required for deep plowing, the soil is comparatively easy to keep in a good, pulverulent condition, as the material crumbles on drying.

The largest areas of this type occur along Cedar, Yegua, New Year, East Mill, Jackson, Kuykendall, and Caney Creeks. It comprises narrow strips of bottom land along most of the streams of the county, but in places these are so narrow that they can not be shown separately on the map.

The Trinity clay occupies the overflowed first bottoms of streams, rising either within local or adjoining areas of the Houston soils. Its surface is flat, being relieved only by such minor changes as are brought about by the shifting of the channel of a stream. Owing to its almost level topography and close association with streams which overflow, the drainage of the type is deficient. During high spring freshets the type is nearly everywhere inundated, although in places where the stream channels are deep it is overflowed only during exceptional floods. In a few instances levees have been constructed, but by far the greater part of the type is unprotected. As this is one

of the most productive soils in the county, the construction of levees or dikes, and ditches to provide for the removal of surface water, should prove profitable.

Most of the type is forested with overcup oak, pin oak, white ash, red elm, white elm, black walnut, and a little pecan and poplar. About 20 per cent is in intertilled crops. Some areas are used for the production of hay. The forested areas are frequently utilized for the grazing of beef cattle, while the cleared areas are successfully used for the production of cotton and corn, where destructive overflows do not occur. Corn yields 30 to 50 bushels and cotton one-fourth to one-half bale per acre. Owing to the rank growth of cotton on this type, a greater loss is caused by the boll weevil than on the upland soils, where the stalk is usually shorter and the plant fruits earlier. A large part of the hay produced in the county is grown on this type. Johnson grass does well and yields from 3 to 5 tons per acre. When properly reclaimed, this soil makes excellent land for the production of cotton, corn, alfalfa, and Johnson grass. The soil also gives satisfactory yields of Japan clover, sweet clover, and cowpeas.

No fertilizers of any kind are used. The producing power of this soil is practically the same as when cultivation was begun. Where unprotected from floods the soil is well prepared in the spring and kept fallow, to prevent the weeds from gaining a foothold, until the danger of spring floods is over. In the case of the cotton crop, however, early planting is necessary on account of the boll weevil.

The type has a value of \$30 to \$60 an acre, depending mainly on conditions as regards drainage.

BROWN SOILS.

RESIDUAL MATERIAL—SHALE AND SANDSTONE.

CROCKETT SERIES.

The Crockett soils are dark gray, ranging to grayish brown, with mottled red, gray, and black subsoils, the red mottling being a distinguishing characteristic. The series is developed as isolated prairie areas in the forested region of Texas. It represents a gradation from the black prairie soils of the Houston series to the mottled red clays of the Susquehanna. The soils of this series are derived from calcareous sandstones or beds of clay.

CROCKETT SANDY LOAM.

The Crockett sandy loam varies from the color typical of the series to a brownish yellow or yellowish brown. It consists of slightly loamy sand, underlain at about 24 to 28 inches by a yellow or reddish-yellow,

friable sandy loam which quickly passes into a dull-red or yellowish-red, stiff, compact, heavy clay. In the lower part of the subsoil and the substratum the material is usually sandier and lighter in color than in the upper subsoil, generally having a reddish-yellow color. Waterworn gravel, mainly chert, and yellowish iron oxide concretions are present throughout the soil section in small quantities. Patches of Crockett sand, too small to map separately, are included with this type. The soil is slightly acid, though the subsoil is highly calcareous. As the color indicates, the surface soil is very low in organic matter.

Most of the type occurs northeast of Quarry and north of William Penn along the Yegua Creek bottoms. Several small areas are encountered east of Brenham, and a few others are distributed throughout the county.

The type occupies the crest of ridges, the tops of knolls, and gentle slopes. It has good drainage and is easily cultivated. The soil drifts, though not to such an extent as to destroy crops. It is apparently derived in places from coarse-grained calcareous sandstone or red clay beds containing coarser material than those giving rise to the Crockett fine sandy loam.

Uncleared areas support a dense growth of yaupon, with some post oak, blackjack oak, and prickly ash. About 60 per cent of this type is under cultivation and is devoted to the production of cotton and corn. Cotton yields an average of one-fifth to one-third bale and corn 15 to 20 bushels per acre. This soil is suitable for the production of vegetables, oats, cowpeas, and bur clover, though none of these crops has received attention.

The value of farm lands on this type of soil ranges from \$10 to \$35 an acre, depending on improvements and location.

CROCKETT FINE SANDY LOAM.

The Crockett fine sandy loam consists of a grayish-brown, brown or dark-brown loamy fine sand, underlain at 12 to 20 inches by a plastic, stiff clay or fine sandy clay of a reddish-brown, yellowish-brown, or mottled dull-red and reddish-yellow color. As a rule the subsoil grades into a dull-red to yellowish-red, lighter textured clay at about 30 inches; frequently it is more compact with increase in depth. Quite often there is a greenish tinge to the clay of the subsoil which is very conspicuous when the clay is dry. On the lower slopes there is usually a brownish-yellow to yellowish-brown fine sand stratum, 9 to 10 inches thick, between the surface soil and clay subsoil. On the knolls the clay subsoil is near the surface, and occasionally it is exposed. The depth of soil increases with the descent of the slope, being greatest at the foot. Some chert and yellow iron concretions occur on the surface and throughout the soil section. The

soil is comparatively low in organic matter and is in places slightly acid.

In areas north and northeast of Brenham, in a narrow strip south of the Houston & Texas Central Railroad, along the east side of East Mill Creek, and in other small bands along drainage ways the soil is rather poorly drained and lighter in color. In such places the type consists of a brownish-yellow or brownish-gray fine sand or loamy fine sand, underlain at an average depth of 15 inches by a compact, stiff, tenacious fine sandy clay of a mottled gray or drab, reddish-yellow, and dull-red color. The clay subsoil continues to 30 or 36 inches without any important change except that the material becomes more compact and the gray color in the mottled clay changes to drab.

The type includes some spots, occurring on knolls, of a brownish fine sandy loam, underlain by a yellowish calcareous sandstone about 4 to 8 inches thick. This sandstone rests on a pale-yellow, heavy fine sandy loam to heavy sandy clay, containing pockets of soft, white, calcareous material. In places the sandstone does not occur at the top of the yellowish and whitish subsoil, but at lower depths in the material. Such areas are very small and are fringed with the Crockett fine sandy loam. In the vicinity of Harrison Spring School and immediately northeast of Brenham the soil approaches a sandy loam in texture. A few small patches of true sandy loam, too small to map separately, are scattered throughout areas of the Crockett fine sandy loam.

The type is very easy to handle, and can be cultivated soon after rains. Little attention is paid to the conservation in the soil of water from the winter and spring rains, and crops suffer more or less from lack of moisture during dry periods, although the clay subsoil is retentive of moisture and with care would be able to hold a sufficient store to supply the growing crop.

The Crockett fine sandy loam occurs as a broad, irregular belt extending from Wesley in a northeasterly direction through Brenham and Earlywine to the Brazos River bottoms. There are a number of large areas in the northern part of the county and numerous small scattered areas in other sections.

Where the Crockett fine sandy loam is interspersed with the Houston black clay, it occupies the crests of ridges, the tops of knolls, and stream slopes. In better developed areas it has a gently rolling to rolling topography and occurs on gentle slopes along streams. Along some of the drainage ways this type is rather steep and includes numerous outcrops of calcareous sandstone. The drainage is good, except on some of the gentle slopes along streams and divides. Practically no erosion has taken place on this type.

Approximately 40 per cent of this type is still forested or in permanent pasture. All of it originally supported a forest consisting of post oak, blackjack oak, pin oak, overcup oak, yaupon, hackberry, mulberry, prickly ash, and elm, with red cedar along the streams.

The Crockett fine sandy loam is the second most extensive type in the county. Where the color of the soil is dark brown, it is known as "black sand" and where lighter as "yaupon land." It is not as good soil for growing cotton and corn as the Houston soils, but is a better type for use in producing sweet and Irish potatoes, cowpeas, peanuts, bur clover, and garden vegetables. Corn yields an average of 25 bushels and cotton one-fourth to one-third bale per acre, and with the best methods of fertilization and soil management much better yields can be obtained. Only a very small acreage is devoted to the special crops.

This type ranges in value from \$25 to \$50 an acre, depending on location and improvements.

Crockett fine sandy loam, deep phase.—The Crockett fine sandy loam, deep phase, comprises areas which have a considerably greater depth of sandy material over the clay subsoil, and which carry less organic matter in the surface soil. The soil of this phase consists of a brownish-gray or grayish-brown loamy fine sand which, at about 15 inches, passes into a brownish-yellow to pale-yellow slightly loamy fine sand. At an average depth of 30 inches a mottled gray, yellowish-red, and dull-red, plastic, stiff clay is usually encountered. A thin stratum of mottled yellow and gray, sticky sand usually occurs above the clay subsoil. The phase includes spots of Crockett fine sand, in which the clay is encountered within the 3-foot section, but such areas are too small to be shown separately on the map. They are frequently developed as very narrow strips along the stream bottoms.

This phase is rather droughty, owing to the porous condition of the soil. It drifts when thoroughly dry, and the areas are in many cases known as "sand blows."

The largest areas of the phase border the bottoms of Yegua and Caney Creeks. Other areas are found in different parts of the county.

This soil occurs on the tops of knolls and the crests of ridges and largely on gentle slopes along streams. It has good drainage. The vegetation is the same as that on the typical Crockett fine sandy loam, except that there is more yaupon.

Cotton and corn are practically the only crops. The yields are low, being lighter than on the typical soil.

The land value ranges from \$10 to \$25 an acre.

The following table gives the results of mechanical analyses of samples of the typical soil and subsoil of the Crockett fine sandy loam:

Mechanical analyses of Crockett fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
443915.....	Soil.....	0.1	3.7	10.6	49.4	23.0	7.4	5.7
443916.....	Subsoil.....	.0	2.4	5.6	31.2	12.0	10.2	38.7

SEDIMENTARY MATERIAL—SANDS AND CLAYS.

LUFKIN SERIES.

The surface soils of the Lufkin series are gray, with gray to mottled gray and yellow, impervious, plastic subsoils. The topography is prevailingly flat, and this, together with the impervious subsoils, renders the surface drainage and underdrainage poor, water often standing for long periods after heavy rains. These soils are locally known as "flatwoods land" and "dead land." They are derived from unconsolidated deposits of sand and clay laid down in the Coastal Plain.

LUFKIN FINE SAND.

The Lufkin fine sand is a gray fine sand, with a depth of about 30 inches, passing gradually into a lighter gray loamy fine sand, which is underlain at 3 to 5 feet by a gray or mottled gray and yellow clay.

This type is developed in a few small bodies in the western part of the county. The surface is gently rolling and the drainage is good to excessive. Uncultivated areas support a growth of dwarfed oaks.

Owing to the porous condition of the soil it is very droughty. Cotton and corn are the principal crops. The yields are low.

Land of this type may be purchased for \$20 to \$30 an acre.

LUFKIN GRAVELLY SANDY LOAM.

The soil of the Lufkin gravelly sandy loam consists of a grayloamy fine sand or light fine sandy loam, 6 to 10 inches deep, underlain by a gray or yellowish heavy fine sandy clay, which extends to a depth of 3 feet. In the proximity of the Crockett soils the subsoil is red in places. The soil and subsoil carry a large percentage of subangular and waterworn gravel. These decrease in quantity with depth, being almost absent at 4 or 5 feet from the surface. The gravel consists largely of chert, sandstone, granite, and quartzite. The soil is low in organic matter, and is acid according to the litmus paper test.

Owing to its gravelly character and uneven surface the soil is difficult to handle. It occupies a higher position than the Lufkin fine

sandy loam, is freely drained, and crops sometimes suffer during long periods of drought. The soil can be cultivated under almost any moisture condition.

The Lufkin gravelly sandy loam occurs in the western part of the county, where it forms the higher elevations in the drainage divides occupied by the Lufkin fine sandy loam.

In places it has a rather rolling to hillocky surface, with deep ravines. This type extends into Lee County, where it is more extensively developed.

Originally the type supported a growth of stunted post oak and blackjack oak. Most of it is forested still and used largely for pastures. A few small fields are devoted to the production of cotton and corn. They produce about 15 bushels of corn and one-fourth bale of cotton per acre.

Land of this type of soil ranges in price from \$10 to \$20 an acre.

LUFKIN FINE SANDY LOAM

The Lufkin fine sandy loam is a brownish-gray loamy fine sand to light fine sandy loam, underlain at about 8 to 10 inches by a brownish-gray to dark-drab fine sandy loam which grades at 12 to 16 inches into a dark-drab to nearly black or mottled gray and yellow, waxy, tough, plastic clay, carrying appreciable quantities of fine sand. This clay in places continues to 36 inches or more with little change, but it usually becomes lighter in color as the depth increases, the lower part of the subsoil generally being light gray or drab. In places the subsurface fine sandy loam layer is absent and the loamy fine sand is directly underlain by a tough clay. In spots the clay subsoil is encountered within a few inches of the surface. On the slopes the soil is lighter in color and has better drainage. In such situations the type consists of a light grayish brown to brownish-gray fine sand, which passes gradually into a gray fine sand to loamy fine sand, grading into a gray or drab fine sandy loam. The subsoil, beginning at about 14 to 20 inches, is a drab, gray, or mottled drab and yellow plastic clay, which in the lower part is usually quite sticky and mottled with gray, yellow or yellowish brown. The soil has a comparatively low organic-matter content, and is acid according to the litmus paper test. Some waterworn chert gravel occurs on the surface and throughout the body of the soil, the quantity increasing as the type approaches the Lufkin gravelly sandy loam.

Owing to its sandy nature, this type can be cultivated under a wide range of moisture conditions, though there are water-logged areas in which the soil dries out very slowly. It is easily handled and does not require very heavy teams or farm implements.

The Lufkin fine sandy loam occurs only in the extreme western part of the county, beginning 2 or 3 miles west and northwest of Bur-

ton and extending into Lee County, where it is more extensively developed. It is more or less interrupted by the Lufkin gravelly sandy loam.

This type has a level to undulating topography and lies considerably lower than the surrounding Houston and Crockett soils. Except on the slopes and higher elevations, it has poor drainage, owing both to its impervious subsoil and its flat topography.

The type was originally forested with stunted post oak and black-jack oak, and about 75 per cent of its area still is forested and utilized for pasturage.

On the cleared areas corn and cotton are the chief crops. The yields are low, owing to the rapid drying out of the soil during droughts. Cotton produces about one-fourth bale and corn 15 to 20 bushels per acre. Where the soil is properly drained it is suited for growing peanuts, cowpeas, beans, Irish potatoes, and a number of vegetables. Artificial drainage is necessary to put this soil in the best possible condition for cultivation.

Land values on this type range from \$20 to \$50 an acre, depending on improvements.

RED SOILS.

WATER-LAID MATERIAL (RECENT ALLUVIUM)—SHALE AND SANDSTONE.

MILLER SERIES.

The Miller soils are prevailingly red, ranging from grayish brown or chocolate brown to pinkish red. The subsoils are chocolate red or pinkish red. The soil and subsoil are calcareous. These soils are developed in the first overflow bottoms of streams, issuing from the regions underlain by the Permian Red Beds. They are typically developed along the Brazos and Red Rivers in Texas and Louisiana. There are large areas that are rarely overflowed.

MILLER VERY FINE SANDY LOAM.

The soil of the Miller very fine sandy loam consists of a reddish-yellow or light reddish brown very fine sandy loam, in many places approaching a silt loam. It extends to a depth of 20 to 24 inches, and is underlain by a chocolate-red, stiff, tenacious clay. Both soil and subsoil are highly calcareous. This type is easy to handle and can be cultivated under a wide range of moisture conditions. Owing to its clay subsoil it conserves moisture well.

The Miller very fine sandy loam occurs in the first bottoms of the Brazos River, mainly as a narrow, irregular strip along the stream bank, though a few small areas are encountered away from the stream. The areas are higher above the stream than the Miller clay. In

general the surface is almost level. The type has good drainage, though occasionally flooded by the Brazos River.

The forest on this type is practically the same as on the Miller clay, except that it includes cottonwood along the banks of the Brazos River.

Cotton does not do as well on this type as on the Miller clay, but corn, sweet potatoes, and Irish potatoes do better. Cotton yields an average of one-half bale, corn 40 to 50 bushels, and sweet potatoes 150 to 200 bushels per acre. In some cases a yield of 300 bushels of sweet potatoes is obtained. Alfalfa does well on the very fine sandy loam areas. The soil is suited to the growing of peanuts, though the crop has received but little attention. It is also well suited to the growing of tomatoes, melons, and other vegetables. No fertilizers are used by the farmers on this soil.

The Miller very fine sandy loam has practically the same value as the Miller clay.

In the following table are given the results of mechanical analyses of samples of the soil and subsoil of the Miller very fine sandy loam:

Mechanical analyses of Miller very fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
443922.....	Soil.....	0.1	0.1	0.1	39.3	40.4	13.6	6.1
443923.....	Subsoil.....	.0	.2	.1	1.3	6.3	52.8	39.3

The following samples contained more than one-half of 1 per cent calcium carbonate (CaCO_3): No. 443922, 6.48 per cent; No. 443923, 11.93 per cent.

MILLER CLAY.

The Miller clay consists of a light chocolate red to dark chocolate red heavy clay, which changes but little within the 3-foot section, though the material is heavier and more compact and somewhat lighter in color between 12 and 24 inches. Seams of sand are common in the lower subsoil. When wet, the soil is extremely sticky, but when dry it has a rather loose structure. Both soil and subsoil are highly calcareous, the subsoil effervescing profusely with hydrochloric acid.

The Miller clay includes small areas which, if large enough to map separately would be classed as the Miller very fine sandy loam. There is also a variation along the contact of Miller clay with the Trinity clay, the soil here being a very dark red.

The Miller clay is confined to the eastern and northeastern part of the county, occurring in the first bottoms of the Brazos River and to some extent along Yegua Creek. It varies in width from narrow

strips to areas having a width of 4 miles. The most extensive areas lie about 2 miles northeast of Chapel Hill and in the southeastern part of the county.

The type is almost level, being interrupted only by those minor surface changes due to the presence of low ridges or swells lying parallel with the Brazos River, and slough or bayou depressions which mark the location of old stream channels. The land near the river banks in places is 10 feet higher than that farther back.

As the channel of the Brazos River is very deep, overflows from the stream seldom occur. The streams and creeks which head in the adjoining uplands and flow through the bottom lands on the other hand are likely to flood a large part of the type every spring. A number of farmers have constructed dikes to protect the soil from overflow. The type is fairly well drained, though it may be improved by ditching. Some low-lying areas have inadequate drainage.

Originally the Miller clay supported a growth of white oak, red oak, hackberry, pecan, white elm, red elm, black walnut, and some sweet gum and overcup oak. Now approximately 75 per cent of the type is under cultivation. It is a very durable and productive soil. The crops consist chiefly of cotton and corn, with some alfalfa and Johnson grass. Cotton produces one-half to three-fourths bale and corn 45 bushels per acre. Where the best methods are followed yields considerably higher than those stated are obtained. Alfalfa produces an average of 3 tons of hay, with three cuttings, and Johnson grass 4 tons of hay per acre. Only a small part of the type is devoted to the production of hay. No fertilizers are used on this type. Some fields have been in cultivation for about 80 years and still produce good crops.

The value of farms on this soil ranges from \$40 to \$100 an acre, depending on location, liability of overflow, and drainage conditions.

SUMMARY.

Washington County is in the southeastern part of Texas. It comprises 613 square miles, or 392,320 acres. It is drained mainly by the Brazos River and its tributaries. The surface varies from level to rolling and lies between 200 and 350 feet above sea level.

The first settlement was made in 1822 and the county was organized in 1836. Between 1859 and 1880 there was a steady immigration, mainly of Germans, and during subsequent years, of Poles. The population in 1910 was 25,561. Brenham, population 4,718, is the county seat and most important town.

Two railroads afford good transportation facilities.

The climate is mild and agreeable. The annual mean temperature is 67° F. There is an average annual precipitation of 37.8

inches, a greater part of which occurs in the winter and early spring. The average growing season comprises 260 days, and is long enough to mature two crops.

Cotton and corn are the principal crops. On the heavier soils alfalfa is a very profitable crop. Large quantities of potatoes are shipped to Kansas City and St. Louis. Beef cattle and hogs are shipped to Fort Worth and Kansas City, and cotton mainly to foreign markets. Agriculture is in a generally prosperous condition.

The soils may be classed in two general groups, the upland soils and bottom-land soils. Five series, comprising 11 types, are mapped.

The Houston types, covering about two-thirds of the county, are dark residual prairie soils. Three types, the black clay, clay loam, and loam, are mapped. Of these, the black clay is the most extensive. The Houston soils are well adapted to cotton, corn, and alfalfa. On the Houston clay loam, however, the cotton frequently dies before maturing.

Two types of the Crockett series, the fine sandy loam and sandy loam, are mapped. These are brown residual soils, and are devoted largely to the production of cotton and corn. They are better adapted to sweet potatoes, Irish potatoes, cowpeas, beans, bur clover, small vegetables, and peanuts.

The Lufkin series consists of dark-gray to gray soils derived *in situ* from beds of noncalcareous material. It is represented by the fine sandy loam, gravelly sandy loam, and fine sand types. Fairly good crops of cotton and corn are grown on these soils, except on the gravelly sandy loam which in most places is too rough and gravelly to be cultivated.

Two soils of the Miller series, the clay and very fine sandy loam, are mapped. The Miller clay is one of the most productive soils in the county. It is well adapted to cotton and corn and, where diked, to alfalfa. The very fine sandy loam is suited to sweet potatoes, Irish potatoes, and peanuts, though cotton and corn, especially the latter, do well.

The Trinity clay consists of a dark-colored soil which is high in lime and organic matter. It ranks with the Miller clay in productiveness. When properly protected from overflow, it is a good cotton and corn soil.



[PUBLIC RESOLUTION—No. 9.]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

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